

Process Safety Accident Analysis in Process Chemical Industries
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ABSTRACT

Process safety accident analysis is through investigation of incidents to identify the chain of events and causes so that corrective measures can be developed and implemented in order to reduce the consequences of future similar incidents. Leveraged strategies that minimise the occurrence of entire types of accidents can be created by recognising and resolving the root causes of equipment failures and personnel errors. In this era of development, many chemical industries are run around the world but for this safety accident analysis only focused on refinery, petrochemical plant, gas processing plant and the upstream within 1998 until 2018. This industry is in very high demand to make a chemical-based product and it also produces products from those chemicals via domestically and to the worldwide. But there are many accidents that occur that lead to the both large and small losses in the process chemical industries. Hence, the accidents that happened in major losses, generally occur because of the failure of a number of the system or barriers within the process safety management system. For many years, accidental releases of toxic, reactive, flammable liquids and gases, have been recorded in processes involving highly dangerous chemicals that can lead to fires, explosions or the accidental of hurricane, leak and others. The main of contributor that led to the accidents such as human error, organizational error, design error and the technical error. All the accidents occurred may lead to the damages of equipment, environment, and affect the large-scale health and welfare employees. Lack of understanding and information on the what event that can contribute to the accident may later result in future similar accidents. Research methods are split broadly into quantitative and qualitative methods in order to produces a richer and more comprehensive understanding of research area. These methods use is based on the accidents analysis data on chemical substances involved, types of hazards, operating parameter conditions, types of equipment, accident contributors and types of process. The main objective of this study is to identify the root cause in order to get to the underlying cause of the harm from the accidents occurred and describing corrective measures to prevent similar future accidents. The data or result collected were different for each types of accidents because it depends on different analysis data or underlying causes. The framework was developed based on literature review from investigation reports, journals, articles and other sources. For this study, there are 80 different types of accidents on 4 different types of industry plant that mentioned earlier chosen and identified. The guideline of identification of the hazards offers an opportunity for the redesign of the unit or equipment to remove or substantially reduce the risk, but where the risk cannot be reduced to tolerable levels by feasible redesign, in order to meet the applicable requirements, additional safety measures which need to be implemented. In these 80 accidents that were studied, the cause primarily due to equipment, human and

organizational error. Based on the analysis of 80 accidents, the results show that tanks have higher possibility which is 21.51% to occur accident in process chemical plant. Most companies follow those standards and guidelines in the design, construction and operation, but tank accidents still occur. Explosion account for 43% of the accidents. There were 80 accidents, (48.33%) caused by human error which is more to organizational error 27.22% and (51.67%) caused by equipment errors which is more to technical error 27.22 %. Other causes were type of process. Most of those accidents would have been avoided if good engineering have been practiced. In conclusion, this study able to improve learning from accidents and indirectly reduce accident rates in the industry.

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1.0 INTRODUCTION

The process chemical industry is booming with the growth of the world's industrialization and the growing population, and chemical plant accidents continue to increase rapidly. Many chemical plant explosion accidents occur along with the development of the chemical industry. Because most of the raw materials are flammable, explosive, poisonous and dangerous, chemical plants have become a high-risk area for safety incidents because the manufacturing process is hazardous. The interaction and effect of different variables greatly increase the complexity of the evolutionary phase of such accidents.

Chemical disasters are considered disasters that are caused by the improper use and abuse of chemicals in industries. Widespread destruction will result from the reckless handling of powerful chemicals. Industrial disasters include incidents caused by mishaps or accidents in manufacturing or related operations, as well as disasters affecting industrial functions, property and development. Both natural and human-made sources can cause a chemical disaster. Chemical disasters are occurrence of emission, fire or explosion involving one or more hazardous chemicals in the course of industrial activity such as handling, storage or transportation.

This study provides a structure for the complex assessment of explosion incidents at chemical plants. 80 totals of accidents were analyzed in chemical plant consist of 4 types which is petrochemical plant, refinery, gas processing plant and upstream plant. The study on the accidents occurred around the world within 1998 until 2018. This industry is in very high demand to make a chemical-based product and it also produces products from those chemicals via domestically and to the worldwide. This scope limitation for this study were seven factors such type of equipment, process, hazards, process conditions and other accident contributors that led to catastrophic accident in process chemical industries. But there are many accidents that occur that lead to the both large and small losses in the chemical industries.

1.1 Problem Statement

Lack of understanding and information on the what event that can contribute to the accident may later result in future similar accidents. This has resulted in several studies aiming to determine the root cause of these injuries in order to include effective prevention steps. Sometime, certain company and people did not know that the simple contributor or events also can lead to accident.

Unexpected thing never alarmed someone. People were never alarmed by the sudden. For several years, many reports of accidental releases of flammable liquids and gases, reactive substances, and toxic substances have been recorded in operations containing extremely hazardous chemicals that have killed employees and caused injury. Regardless of the industry that uses these highly hazardous chemicals, if they are not adequately handled and controlled,

there is a risk of unintended release at any moment. In exchange, it raises the probability of tragedy. Prevention is easier than cure until it brings the unwanted disaster into being.

1.2 Objectives

The main objective of this study is to improve learning from accidents in chemical process industries. The objective is detailed as follows:

- i. To study the accidents occurred in a few types of chemical process industry; i) gas processing, ii) petrochemical, iii) refinery, and iv) upstream plant within 1998 until 2018. Gas processing, petrochemical, upstream and refinery process industry very frequently, and even shows an increasing trend year-by-year.
- ii. To identify types of hazard to be occurred in chemical process industries. Chemical process hazards can be associated with consequence outcomes of fire, explosion, release of toxic substances or combination of these hazards. When unintended accidents occur in the processing, transportation, transport, or other processes of chemicals, they frequently lead to several domino effects which can lead to severe consequences of mass fatalities, destruction of property, and pollution of the atmosphere.
- iii. To identify, classify and rank accident contributors, and determine the origin of their root causes. In order to get to the underlying cause of the harm from the injuries, root cause analysis is necessary. The purpose of this study is to conduct a detailed analysis of the accident process and to define, classify and present all causes on the basis of the available data. There are different types of root cause whether it is caused by human contributor or equipment contributor, process conditions, etc It is of crucial significance for each accident to figure out the different causes and, thus, targeted prevention steps will be taken to eliminate repeated errors and similar potential injuries. The process of these events happening and evolving is always very complicated and requires several various causal causes, so great efforts can be made to help people and organisations remember the cases and valuable lessons better. If the root causes of an accident are not known, only superficial remedies should be taken into consideration but cannot avoid the potential incident of a similar accident. It can conclude, the key point on how to avoid similar mistakes should be remembered, and it is vitally important everywhere within the industry. Thus, useful experiences and lessons could be summarized and learned to provide guidance for the safety management of various enterprises and the safety supervision of government agencies.
- iv. To identify, classify and rank safety hazard. A priority ranking for each hazard of concern is assigned whether the hazard is in a high risk, medium risk or low risk. This objective